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(12) **United States Patent**  
**Yamaguchi et al.**

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(54) **INPUT/OUTPUT DEVICE INFORMATION MANAGEMENT SYSTEM FOR MULTI-COMPUTER SYSTEM**

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(30) **Foreign Application Priority Data**

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(52) U.S. Cl. ..... 709/220; 709/213

(58) Field of Search ..... 709/213, 221, 709/220, 223, 201, 203; 345/330, 733, 735; 710/46; 714/4, 6

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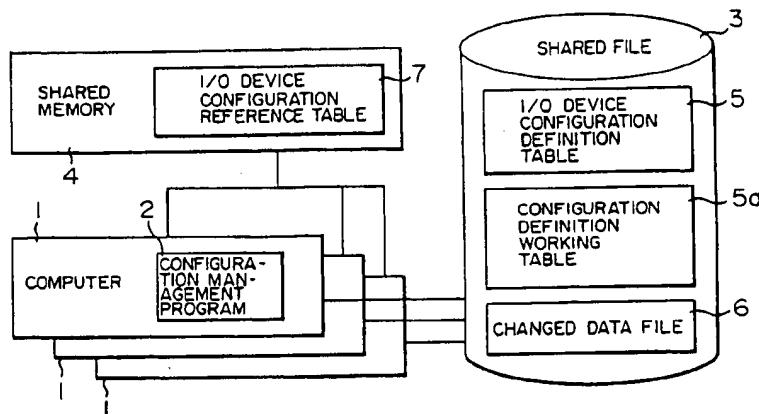
*Primary Examiner*—Mehmet B. Geckil

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(57) **ABSTRACT**

In a multi-computer system having a plurality of computers, an input/output device configuration definition table and an input/output device configuration reference table are adapted to be collectively managed. A configuration management program manages the configuration definition of all input/output devices of a plurality of computers by using the input/output device configuration definition table, and generates a changed data file when an input/output device configuration is changed. Dynamic system alteration is effected by changing the contents of the input/output device configuration reference table stored in a shared memory, in accordance with the changed data file. The input/output device configuration definition table and the input/output device configuration reference table each have an input/output device information part and an input/output device connection information part arranged in a matrix form to allow addition/deletion of an input/output device and a computer.

**20 Claims, 13 Drawing Sheets**



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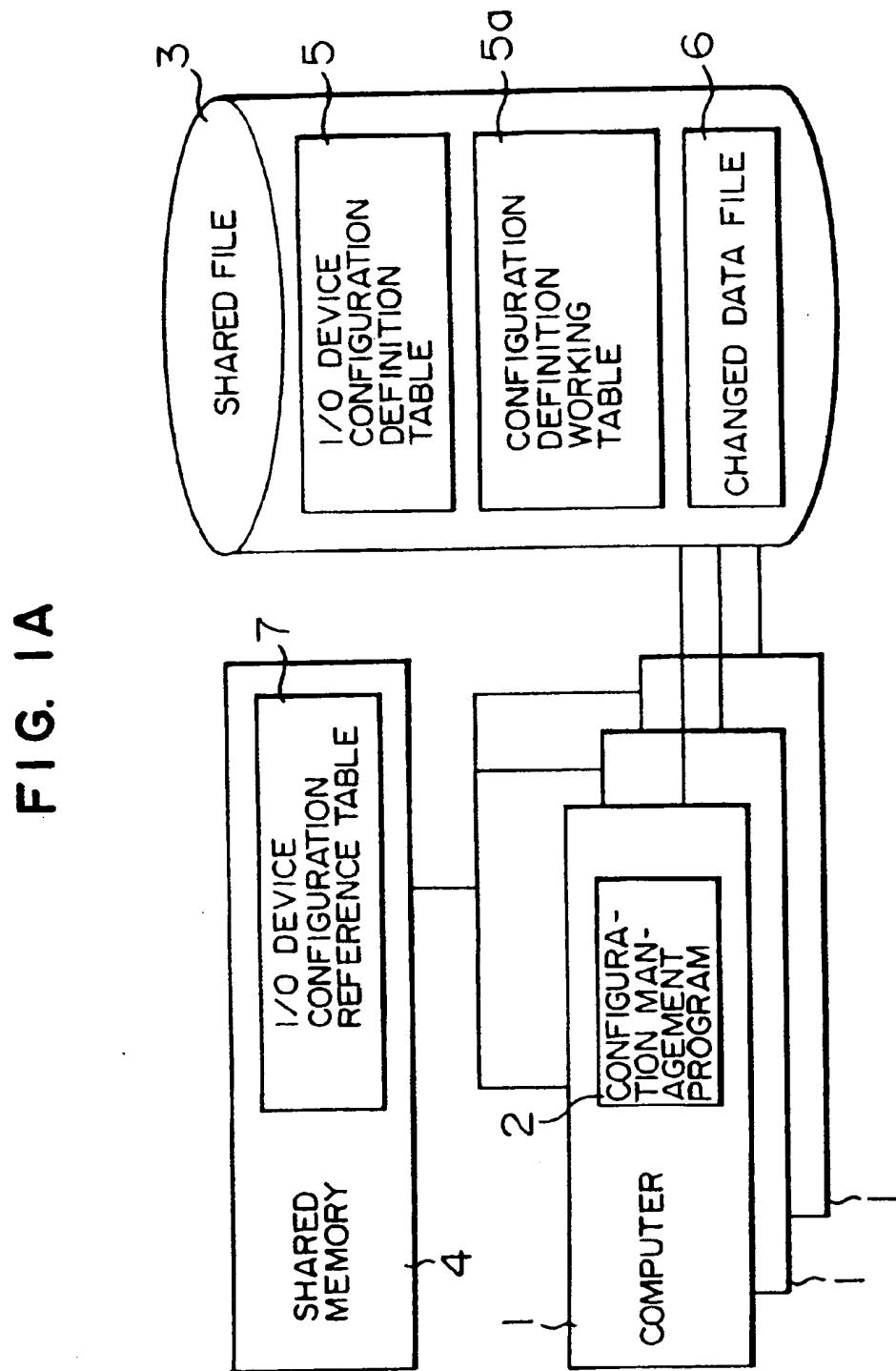
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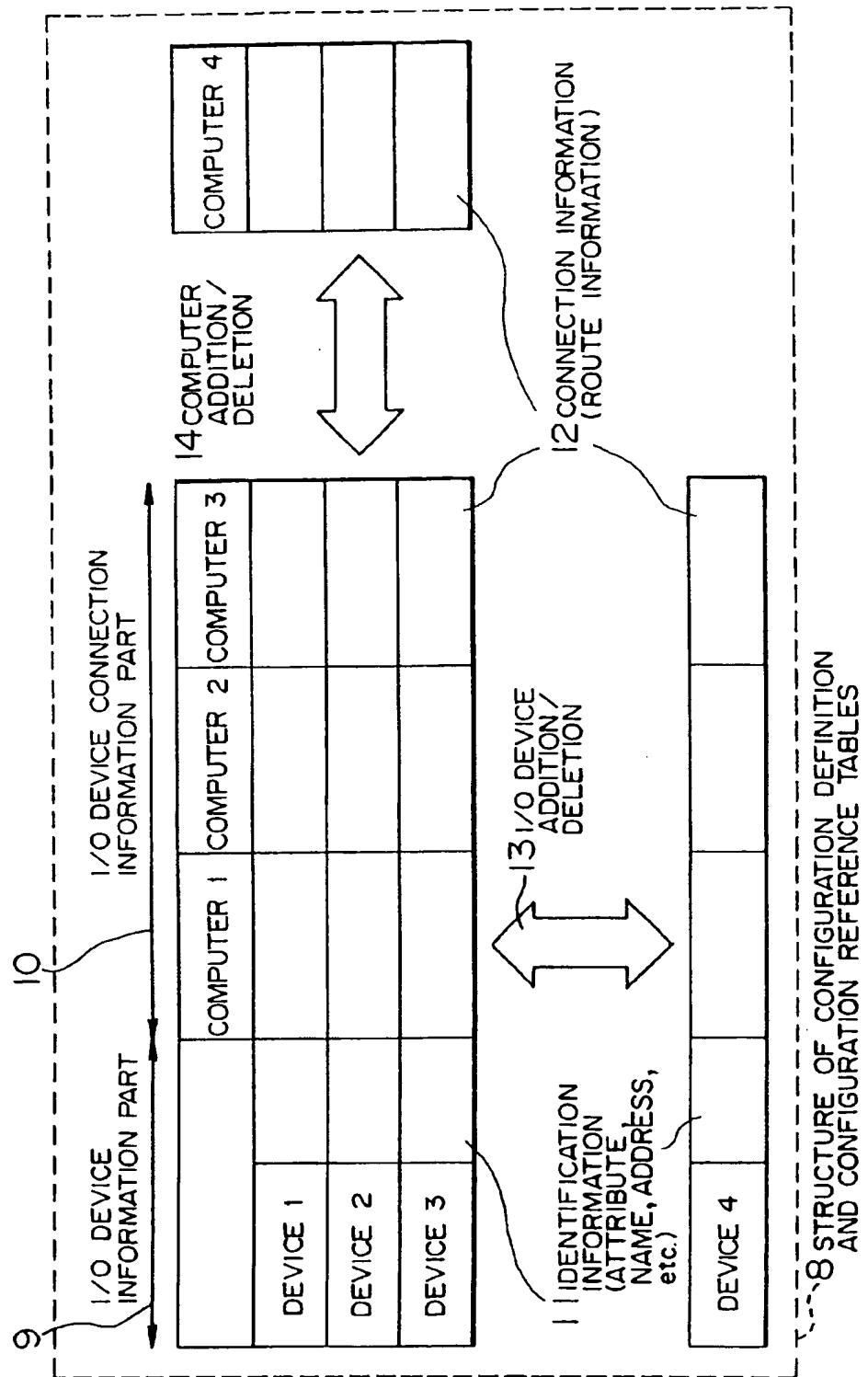
**FIG. 1B**

FIG. 2

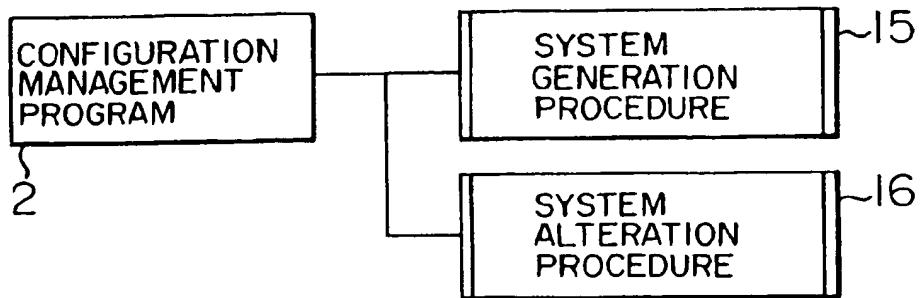


FIG. 3

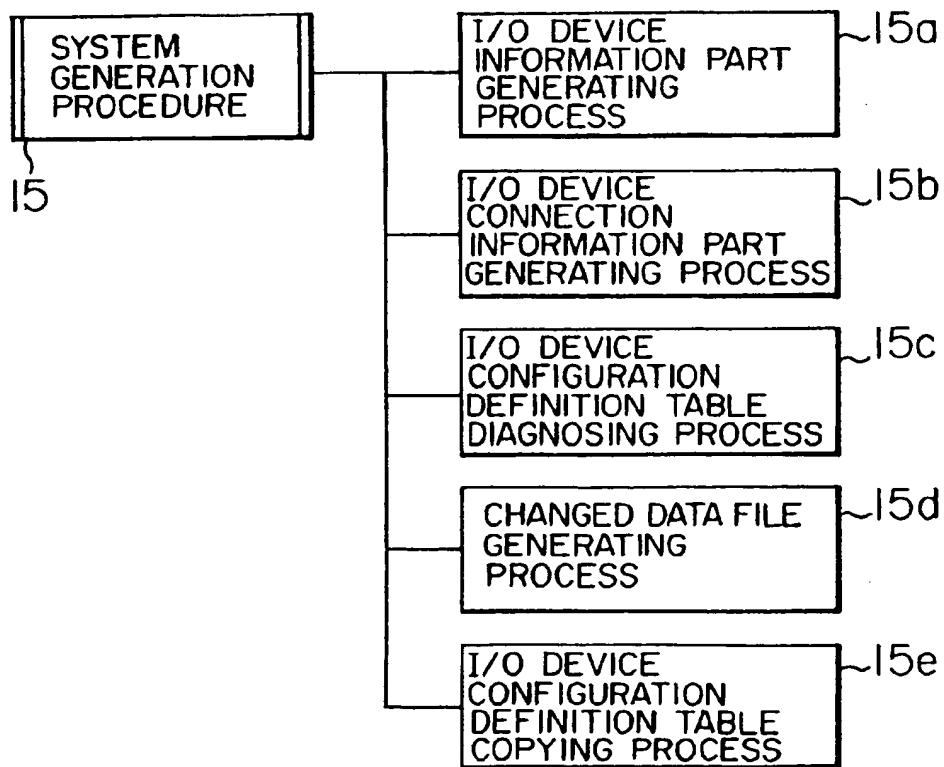
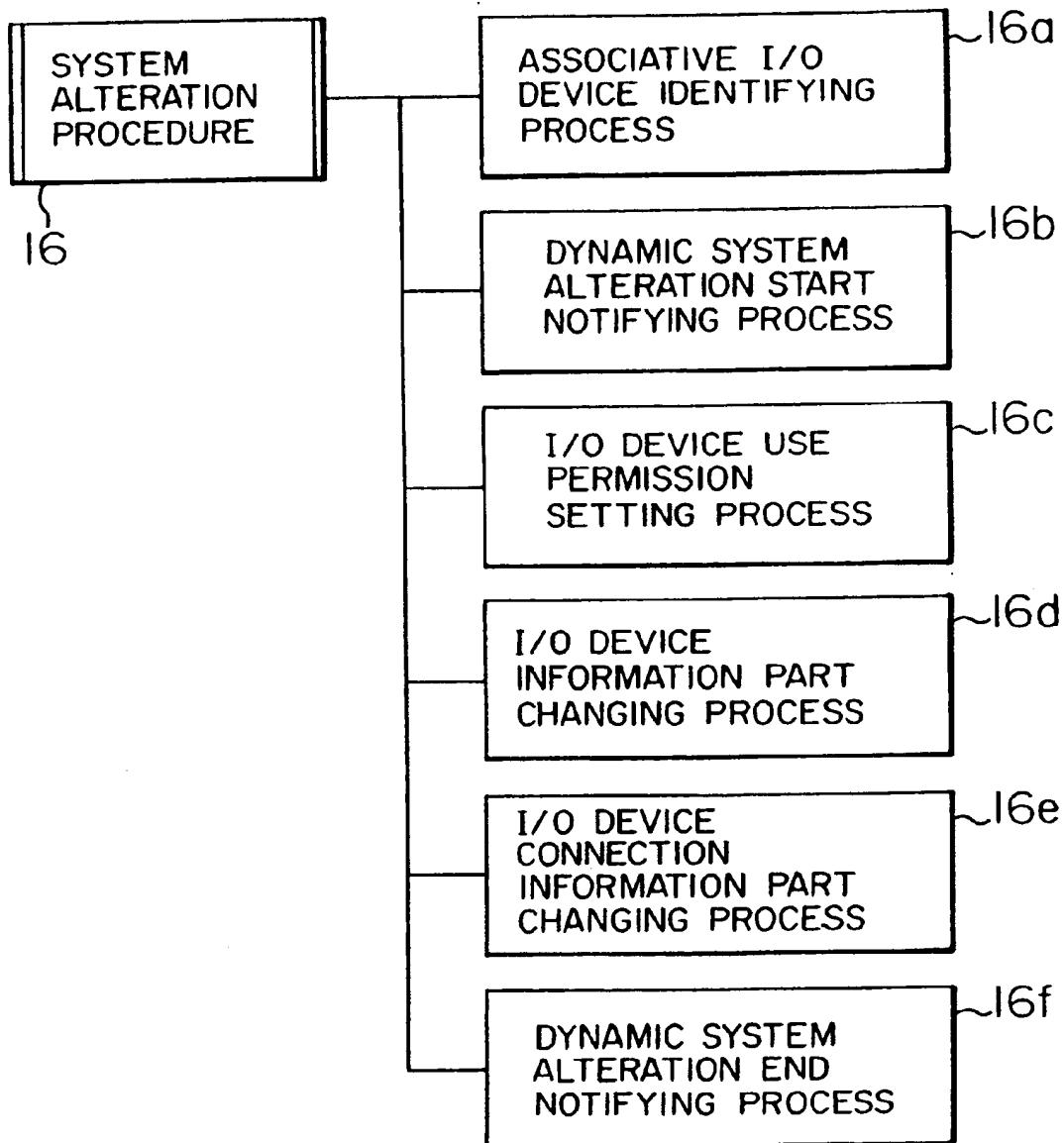
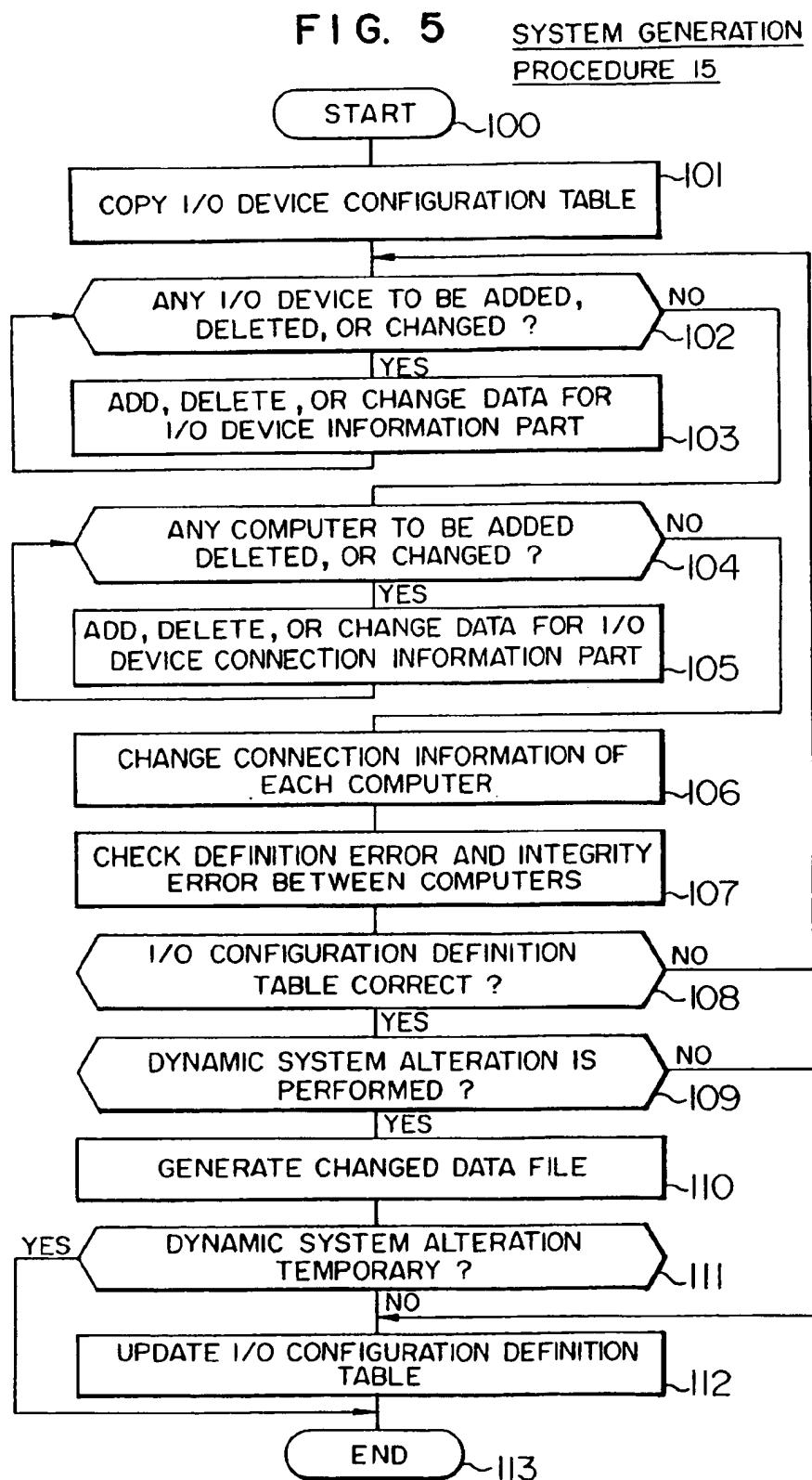
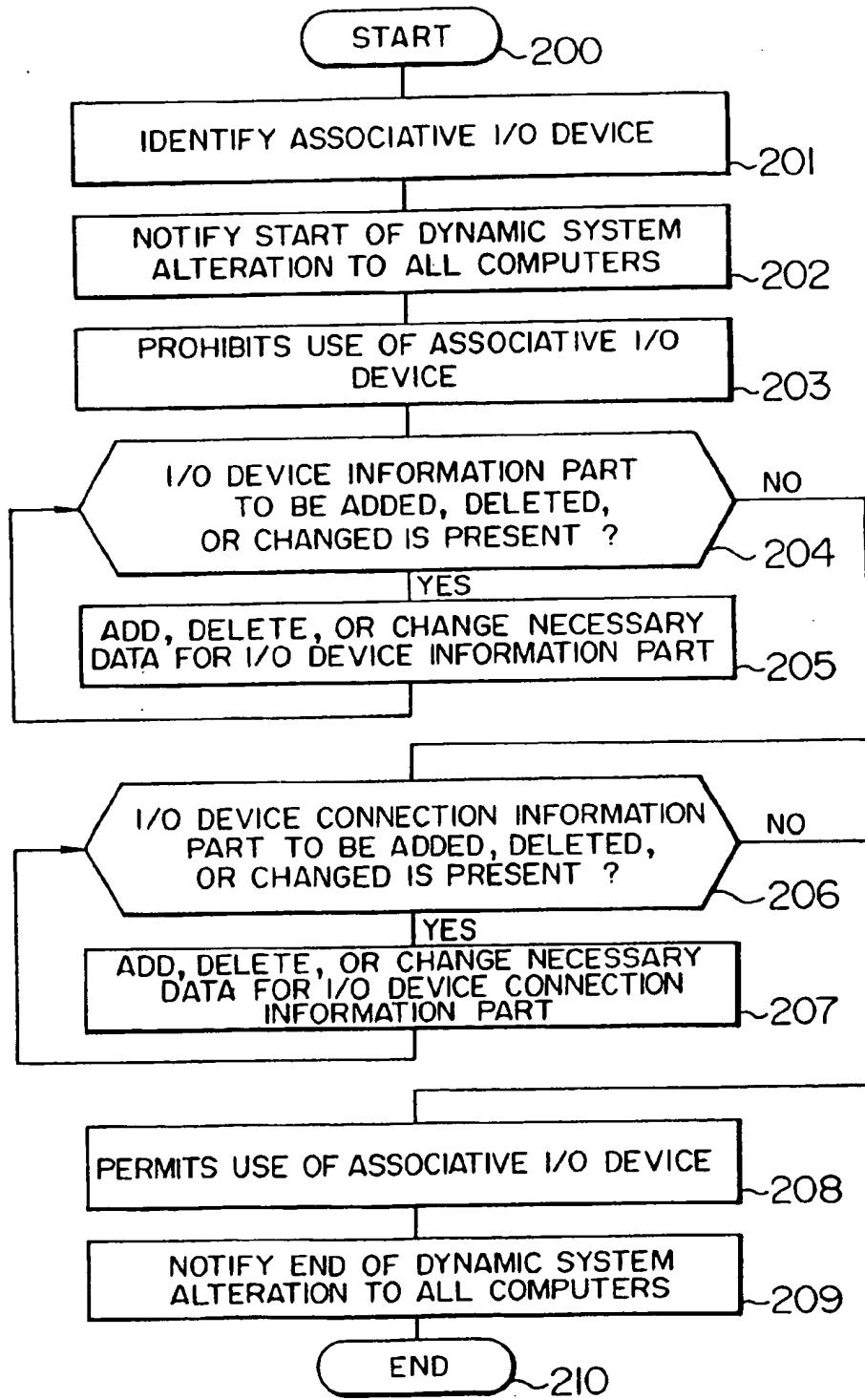


FIG. 4





**FIG. 6**    SYSTEM ALTERATION  
PROCEDURE 16



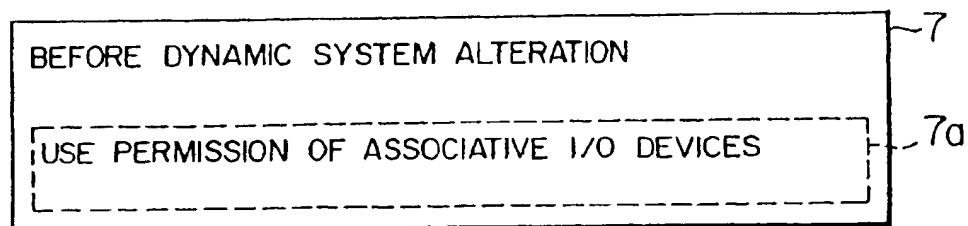
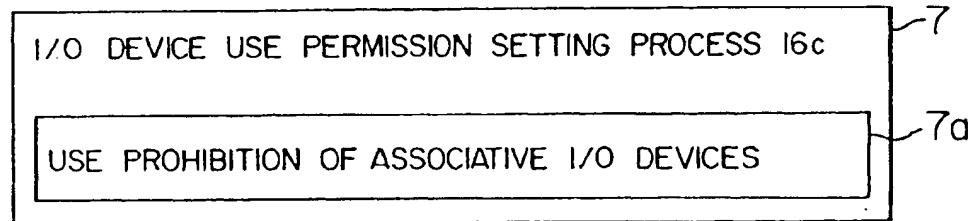
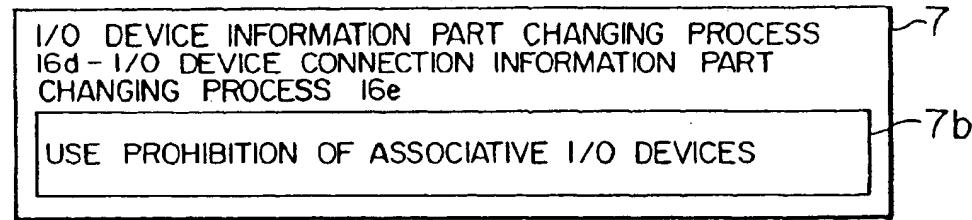
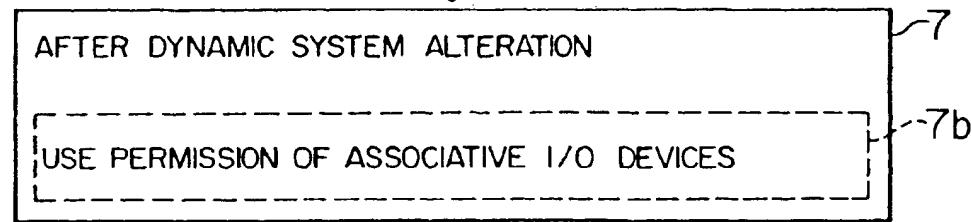
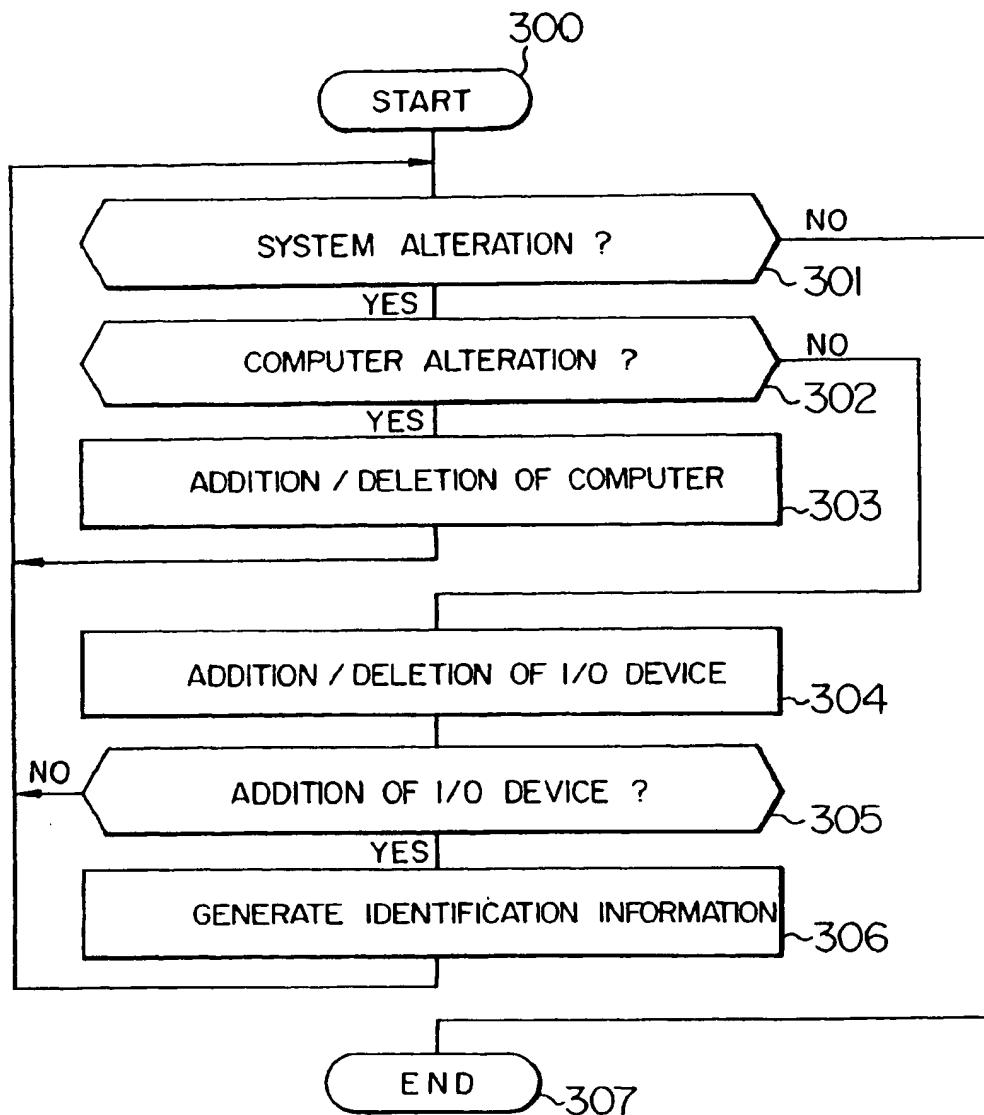
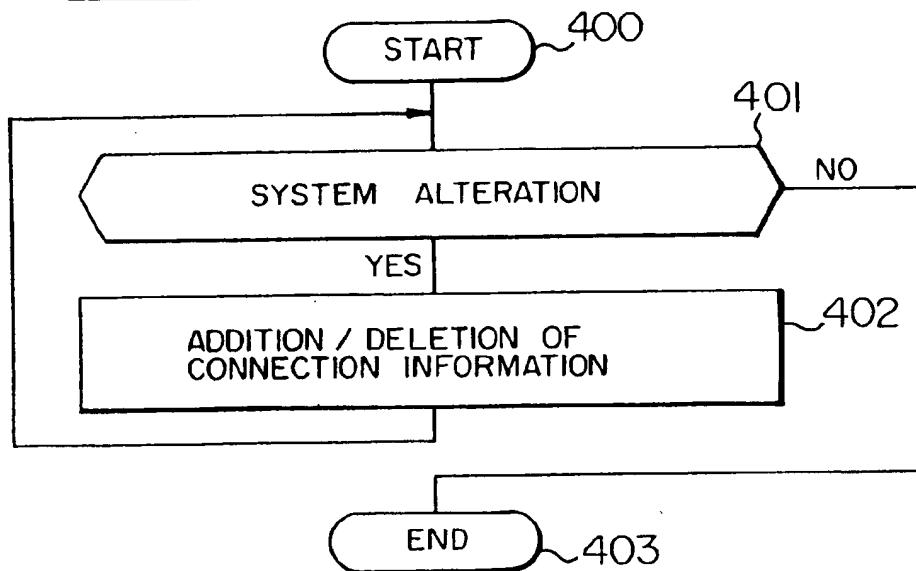
**FIG. 7(a)****FIG. 7(b)****FIG. 7(c)****FIG. 7(d)**

FIG. 8

I/O DEVICE INFORMATION PART GENERATING PROCESS 15a

**FIG. 9**  
I/O DEVICE CONNECTION INFORMATION PART GENERATING PROCESS 15b



**FIG. 10**  
I/O DEVICE CONFIGURATION DEFINITION TABLE DIAGNOSING PROCESS 15c

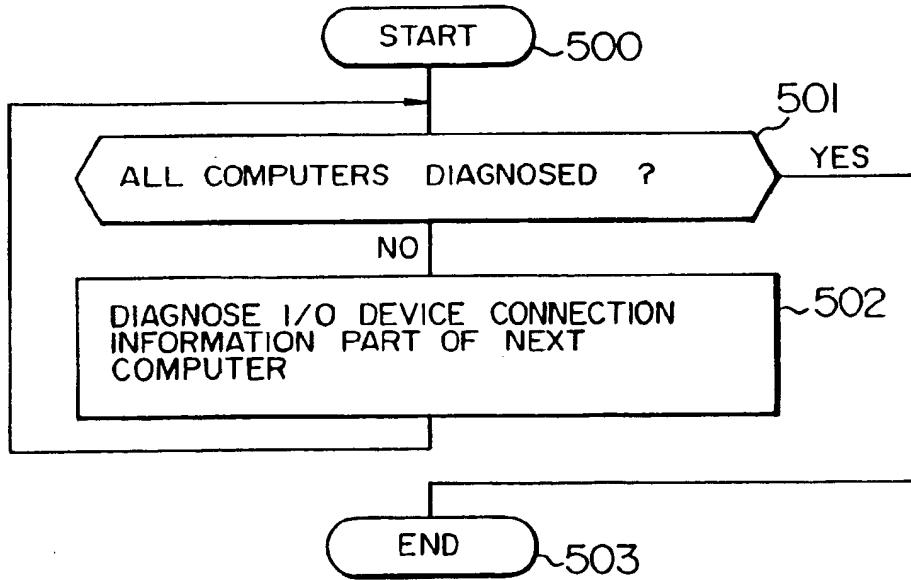


FIG. 11

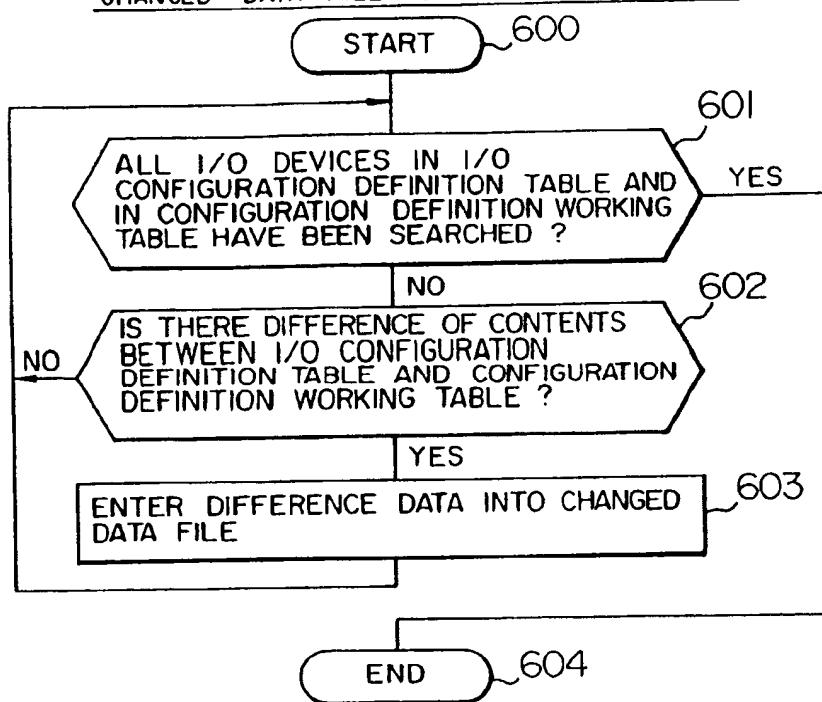
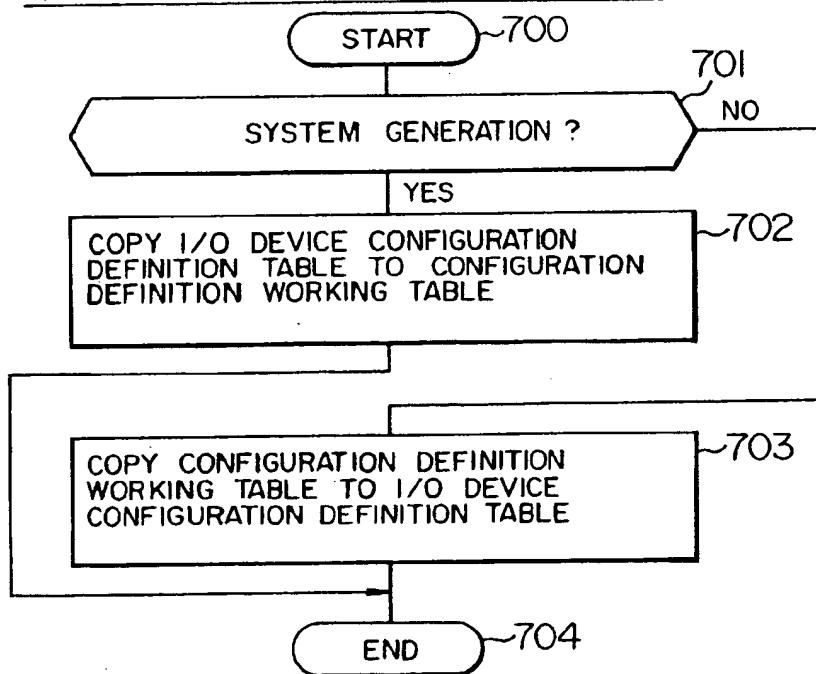
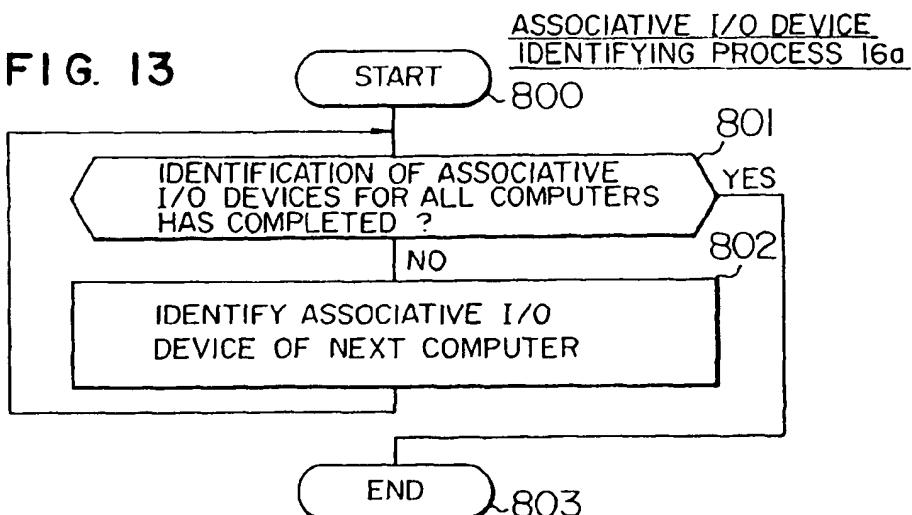
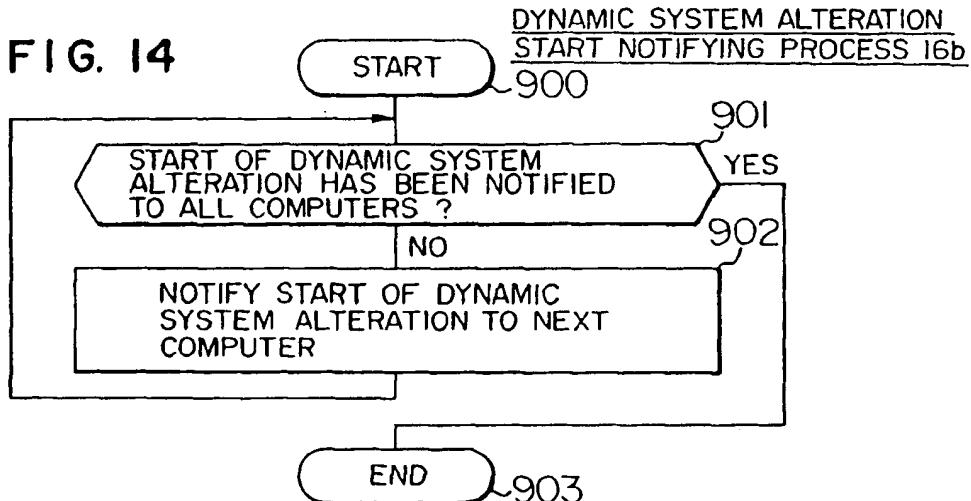
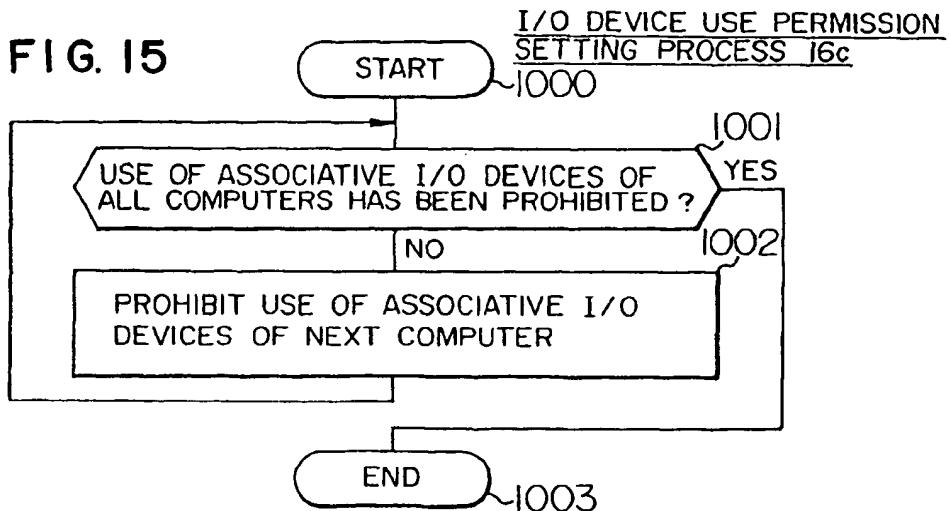
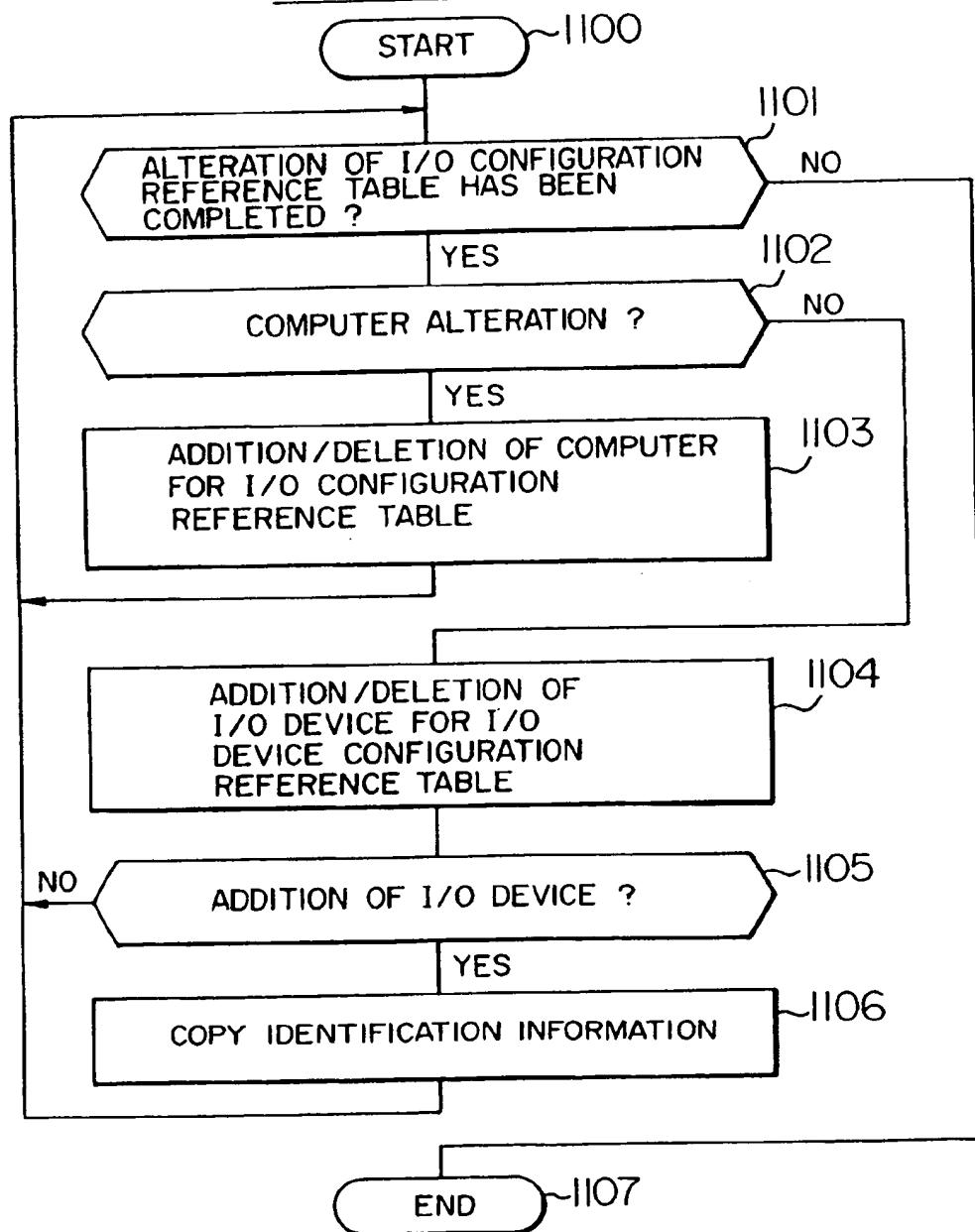
CHANGED DATA FILE GENERATING PROCESS 15d

FIG. 12

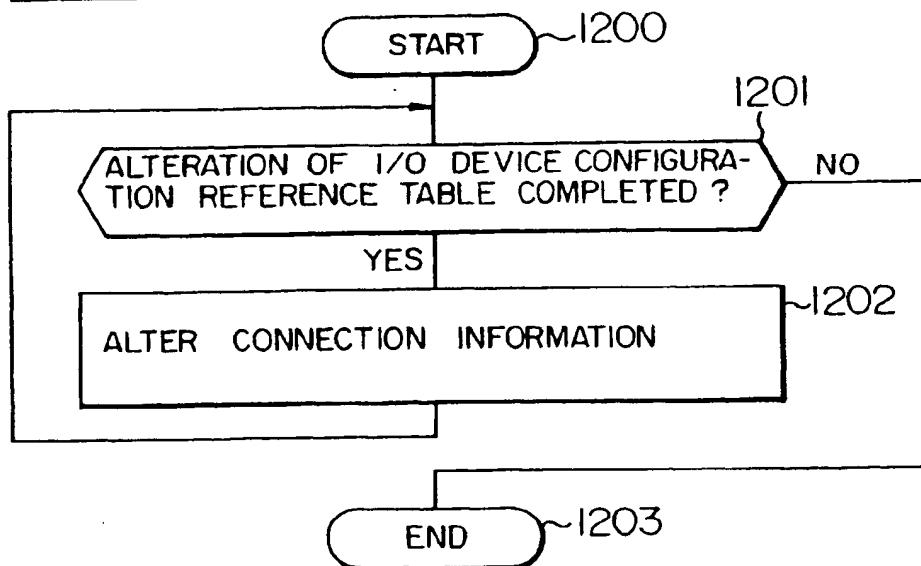
I/O DEVICE CONFIGURATION DEFINITION TABLE COPYING PROCESS 15e

**FIG. 13****FIG. 14****FIG. 15**

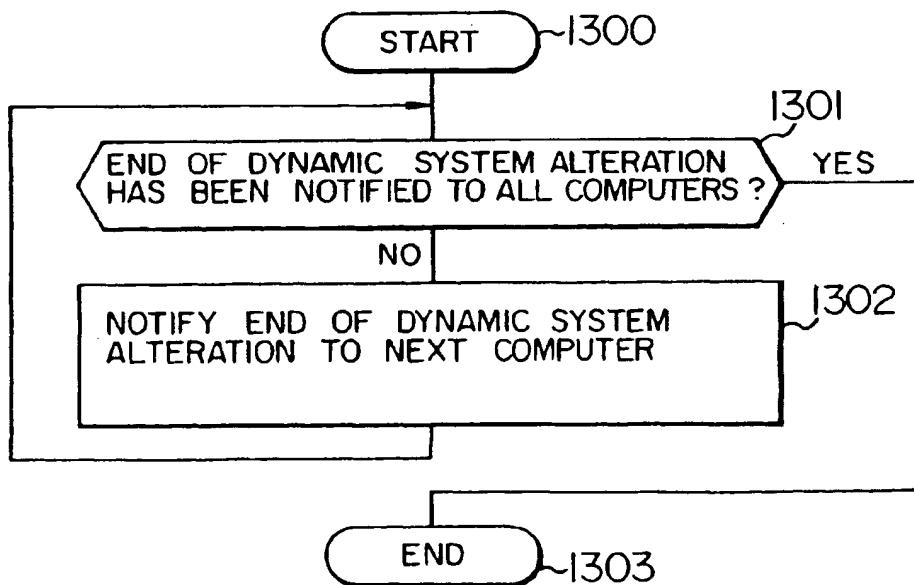
**FIG. 16**  
I/O DEVICE INFORMATION PART  
CHANGING PROCESS 16d



**FIG. 17**  
I/O DEVICE CONNECTION INFORMATION PART CHANGING PROCESS 16e



**FIG. 18**  
DYNAMIC SYSTEM ALTERATION END NOTIFYING PROCESS 16f



**INPUT/OUTPUT DEVICE INFORMATION  
MANAGEMENT SYSTEM FOR MULTI-  
COMPUTER SYSTEM**

This application is a continuation of Ser. No. 08/948,071 filed on Oct. 9, 1997 (now U.S. Pat. No. 6,115,738 issued on Sep. 5, 2000, which in turn is a continuation of Ser. No. 08/371,376 filed on Jan. 11, 1995 (now U.S. Pat. No. 5,717,950 issued on Feb. 10, 1998).

**BACKGROUND OF THE INVENTION**

**1. Field of the Invention**

The present invention relates to a collective management system for input/output device information in a multi-computer system containing a plurality of computers. More particularly, the invention relates to a collective management system for input/output (I/O) device information in which an input/output device configuration table and an input/output device configuration reference table can be updated collectively and at the same time, the former table defining the configurations of all input/output devices used in the multi-computer system and the latter table having a format allowing the reference by each computer for the execution of data input/output of each input/output unit.

**2. Description of the Related Art**

A conventional technique for application Ser. No. 09/638,027 input/output device information, is disclosed, for example, in JP-A-4-90024. According to this technique, a specific computer in a multi-computer system performs system generation to generate volumes resident at each computer.

Another conventional technique is disclosed, in JP-A-3-269754. According to this technique, identification information of input/output devices for each computer is stored in advance in a shared file in the form of database, and a file of input/output device configuration information, which is a combination of connection information and identification information of input/output devices, is formed for each computer.

Conventional technique for dynamic system alteration, is disclosed, for example, in JP-A-3-175532. According to this technique, system generation information, having a format allowing the reference by each computer for the execution of data input/output of each input/output device, is stored in a memory of each computer. After the system generation information is altered by a definition program at one computer, other computers read the altered system generation information.

With the conventional technique for input/output devices, an input/output configuration definition table and an input/output configuration reference table are provided for each computer. It is necessary for each computer of a multi-computer system to define the configurations of shared input/output devices, thereby posing a problem of lowering a resource usage efficiency and increasing the process load of each computer caused by the need of defining the configurations.

With the conventional technique for dynamic system alteration, after an input/output device configuration reference table stored in each computer of a multi-computer system is altered, other computers are required to read the altered input/output device configuration reference table, thereby posing a problem of a need of a number of processes for the addition, deletion, or change of shared input/output devices.

**SUMMARY OF THE INVENTION**

It is an object of the present invention to solve the problems associated with conventional techniques by providing an input/output device information management system for a multi-computer system having a plurality of computers, the management system being capable of collectively managing an input/output device configuration definition table and an input/output device configuration reference table, the former table defining configurations of all input/output devices used by the multi-computer system and the latter table having format allowing the reference by each computer for the execution of data input/output of each input/output device, and being capable of dynamically updating both tables when any alteration such as addition, deletion, and change of an input/output device or a computer is made by a computer during its operation.

The above object of the invention is achieved by an input/output device configuration definition table stored in a shared file of the multi-computer system for defining the configurations of all input/output devices used by a multi-computer system, the input/output device configuration definition table having an input/output device information part and an input/output device connection information part disposed in a matrix form. This table allows the configurations of all input/output devices shared in the multi-computer system to be simply defined.

The above object of the invention is achieved by an input/output configuration reference table stored in a shared memory of the computer network, the input/output configuration reference table being obtained by reading the input/output configuration definition table and transforming the definition table into the format allowing the reference by each computer for the execution of data input/output of each input/output device, and the input/output device configuration reference table having an input/output device information part and an input/output device connection information part disposed in a matrix form. This table allows all input/output devices shared by the multi-computer system to be managed collectively.

In the multi-computer system having a plurality of computers, the input/output device configuration definition table and the input/output device configuration reference table each have an input/output device information part storing identification information of each input/output device such as a type and an attribute, and an input/output device connection information part storing connection information between input/output devices and computers, both the parts being disposed in a matrix form. With the input/output device configuration definition table and the input/output device configuration reference table, a correspondence between all input/output devices and computers of the multi-computer system can be managed collectively.

Any computer can collectively update both the input/output device configuration definition and reference tables by a single set of operations, when an input/output device or a computer is added, deleted, or changed.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1A is a block diagram showing the configuration of a multi-computer system, and FIG. 1B is a block diagram showing the structures of an input/output device configuration definition table and an input/output device configuration reference table;

FIG. 2 is a diagram showing an example of the structure of a configuration management program according to an embodiment of the invention;

FIG. 3 is a diagram showing an example of the structure of a system generation procedure;

FIG. 4 is a diagram showing an example of the structure of a system alteration procedure;

FIG. 5 is a flow chart explaining the operation of the system generation procedure;

FIG. 6 is a flow chart explaining the operation of the system alteration procedure;

FIG. 7a-7d are diagrams explaining a dynamic system alteration for a multi-computer system;

FIG. 8 is a flow chart explaining the operation of an input/output device information part generating process of the system generation procedure;

FIG. 9 is a flow chart explaining the operation of an input/output device information connection part generating process;

FIG. 10 is a flow chart explaining the operation of an input/output device configuration definition table diagnosing process;

FIG. 11 is a flow chart explaining the operation of a changed data file generating process;

FIG. 12 is a flow chart explaining the operation of an input/output device definition table copying process;

FIG. 13 is a flow chart explaining the operation of an associative input/output device identifying process of the system alteration procedure;

FIG. 14 is a flow chart explaining the operation of a dynamic system alteration start notifying process;

FIG. 15 is a flow chart explaining the operation of an input/output device use permission setting process;

FIG. 16 is a flow chart explaining the operation of an input/output device information part changing process;

FIG. 17 is a flow chart explaining the operation of an input/output device information connection part changing process; and

FIG. 18 is a flow chart explaining the operation of a dynamic system alteration end notifying process.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of an input/output device information management system of the invention is described in detail below with reference to the accompanying drawings.

Referring to FIGS. 1A and 1B, the input/output device information management system for a multi-computer system includes computers 1, a configuration management program 2, a shared file 3, a shared memory 4, an input/output device configuration definition table 5, a configuration definition working table 5a, a changed data file 6, an input/output device configuration reference table 7, an input/output device identification information part 9, and an input/output device connection information part 10.

As shown in FIG. 1A, the multi-computer system of the invention includes a plurality of computers 1, the configuration management program 2 running on each computer 1 for managing the configurations of all input/output devices, the shared file 3 for the plurality of computers 1, the shared memory 4 for the plurality of computers 1, the input/output configuration definition table 5 stored in the shared file 3 for storing the data defining the configurations of all input/output devices used by the plurality of computers 1, the configuration definition working table 5a used for editing the input/output configuration definition table 5, the changed data file 6 for storing the changed data of the input/output

configuration definition table 5a, and the input/output configuration reference table 7 stored in the shared memory 4, the input/output configuration reference table 7 being obtained by reading the input/output configuration definition table 5 and transforming the table 5 into the format allowing the reference by each computer for the execution of data input/output of each input/output device.

As shown in FIG. 1B, the input/output configuration definition table 5 and input/output configuration reference table 7 each have the structure indicated at 8 in FIG. 1B.

Specifically, stored in a matrix form are the input/output device information part 9 for storing the data defining the identification information 11 such as a type and an attribute of each input/output device and the input/output device connection information part 10 for storing the data defining the connection information between each input/output device and each computer. By referring to both the parts 9 and 10, addition/deletion 13 of input/output devices and addition/deletion 14 of computers are performed.

The identification information 11 is the definition information of the input/output device entered upon system generation, such as an attribute, a name, and an address of each input/output device necessary for the execution of data input/output of the input/output device.

The input/output device configuration reference table 7 also stores data necessary for the management of each input/output device by each computer, such as whether what input/output device is in use by what computer and whether what input/output device is inhibited to use.

The configuration management program 2 may run on all computers of the multi-computer system or on one or more computers of the multi-computer system. As shown in FIG. 2, this configuration management program 2 contains a system generation procedure 15 and a system alteration procedure 16. The system generation procedure 15 generates the input/output configuration definition table 5 and the changed data file 6. In accordance with the changed data file 6, the system alteration procedure 16 enters the information on addition, deletion, or change of an input/output device and a computer into the input/output configuration reference table 7 for the dynamic alteration of the multi-computer system. The changed data file 6 also stores a dynamic alteration flag. This flag is referred to by the system alteration procedure 16 of the configuration management program 2 when the dynamic alteration is executed.

As shown in FIG. 3, the system generation procedure 15 of the configuration management program 2 includes an input/output device information generating process 15a, an input/output device connection information generating process 15b, an input/output device configuration definition table diagnosing process, a changed data file generating process 15d, and an input/output device configuration definition table copying process 15e.

The input/output information generating process 15a generates the input/output device information part 9 and identification information 11 of the configuration definition table 5.

The connection information generating process 15b generates the input/output device connection information part 10 and connection information 12 of the configuration definition table 5.

The configuration definition table diagnosing process 15c diagnoses whether there is any data error or an integrity error between computers in the input/output device information part 9 and input/output device connection information part 10 of the configuration definition table 5.

The changed data file generating process 15d generates the changed data file 6 which stores the changed data of the configuration definition table 5.

The configuration definition table copying process 15e copies the data in the configuration definition table 5 to the configuration definition working table 5a, or vice versa.

The connection information 12 is the information of a data route from an input/output device of the subject computer to the subject input/output device via a network channel.

As described above, the system generation procedure 15 therefore updates the input/output device configuration definition table 5.

As shown in FIG. 4, the system alteration procedure 16 of the configuration management program 2 includes an associative input/output device identifying process 16a, a dynamic system alteration start notifying process 16b, an input/output device use permission setting process 16c, an input/output device information part changing process 16d, an input/output device connection information part changing process 16e, and a dynamic system alteration end notifying process 16f.

The associative input/output device identifying process 16a identifies any associative input/output device to be affected by the dynamic system alteration, by using the changed data file 6.

The dynamic system alteration start notifying process 16b notifies the start of dynamic alteration of the configuration definition table 7 to all computers of the multi-computer system.

The use permission setting process 16c sets a use permission of an associative input/output device at the timing synchronously with all computers of the multi-computer system.

The input/output device information part changing process 16d changes the input/output device information part 9 of the configuration reference table 7 in accordance with the changed data file 6.

The input/output device connection information part changing process 16e changes the input/output device information connection part 10 of the configuration reference table 7 in accordance with the changed data file 6.

The dynamic system alteration end notifying process 16f notifies the end of dynamic alteration of the configuration definition table 7 and the changed data to all computers of the multi-computer system.

As described above, the system alteration procedure 15 therefore updates the input/output device configuration reference table 7.

Next, the system generation procedure 15 of the configuration management program 2 of this embodiment constructed as above will be described with reference to the flow chart shown in FIG. 5.

First, the configuration definition table copying process 15e copies the configuration definition table 5 to the configuration definition working table 5a. The input/output information part generating process 15a checks whether there is any input/output device to be added, deleted, or changed. If there is such an input/output device, necessary data is added to, deleted from, or changed in, the input/output device information part 9 of the configuration definition working table 5a. In this case, if there is an input/output device to be added, the identification information 11 of the input/output device is defined. (Steps 101 to 103).

After the contents of the configuration definition working table 5a have been changed in accordance with the input/output device to be added, deleted, or changed at Steps 102 and 103, the input/output device connection information

generating process 15b checks whether there is any computer to be added, deleted, or changed. If there is such a computer, necessary data is added to, deleted from, or changed in, the input/output device connection information part 10 of the configuration definition working table 5a. (Steps 104 and 105)

After the contents of the configuration definition working table 5a have been changed in accordance with the computer to be added, deleted, or changed at Steps 104 and 105, the input/output device connection information part generating process 15b changes for each input/output device the connection information 12 of each computer in the input/output device connection information part 10 of the configuration definition working table 5a (Step 106).

After the contents of the configuration definition table 5a have been changed, the configuration definition table diagnosing process 15c checks whether there is any definition error or an integrity error between computers in the changed configuration definition working table 5a. If there is an error, the procedure returns back to Step 102 to correct the configuration definition working table 5a. (Steps 107 and 108)

If the configuration definition working table 5a is judged to be correct at Step 108, it is checked whether a dynamic system alteration is performed. If a dynamic system alteration is to be performed, the changed data file generating process 15d generates the changed data file 6. (Steps 109 and 110)

Thereafter, it is checked whether the dynamic system alteration is temporary. If temporary, the procedure is terminated without updating the configuration definition table 5 (Step 111).

If it is judged at Step 109 not to perform a dynamic system alteration at Step 109 or if it is judged at Step 111 not temporary, the configuration definition copying process 15e overwrites the configuration definition working table 5a to the configuration definition table 5 to update the latter (Step 112).

Next, the input/output device information part generating process 15a of the system generation procedure 15 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 8.

It is checked whether there is a system alteration and whether the configuration definition table 5a is changed (Step 301).

In the case of a computer alteration, addition/deletion 14 (FIG. 1B) of a computer is performed (Steps 302 and 303).

In the case of an input/output device alteration, addition/deletion 13 of an input/output device is performed. In the case of an input/output device addition, the identification information 11 is generated. (Steps 304, 305, 306)

The input/output device connection information part generating process 15b of the system generation procedure 15 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 9.

It is checked whether there is a system alteration and whether the configuration definition table 5a is changed (Step 401).

Necessary data is added to, or deleted from, the connection information 12 (Step 402).

The input/output device configuration definition table diagnosing process 15c of the system generation procedure 15 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 10.

It is checked whether all computers have been diagnosed (Step 501).

The input/output connection information part of the next computer is diagnosed (Step 502).

The changed data file generating process 15d of the system generation procedure 15 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 11.

It is checked whether all input/output devices in the configuration definition table 5 and in the configuration definition working table 5a have been searched (Step 601).

A difference of contents between the configuration definition table 5 and configuration definition working table 5a is stored in the changed data file 6 (Steps 602 and 603).

The input/output device configuration definition table copying process 15e of the system generation procedure 15 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 12.

In the case of system generation start, the input/output device configuration definition table 5 is copied to the configuration definition working table 5a (Steps 701 and 702).

In the case of system generation end, the configuration definition working table 5a is copied to the input/output device configuration definition table 5 (Steps 701 and 703).

Next, the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 6.

First, the associative input/output identifying process 16a identifies an input/output device considered to be affected by a dynamic system alteration, in accordance with the changed data file 6. The dynamic system alteration start notifying process 16b notifies a dynamic system alteration start to all computers so as to prevent two or more computers in the multi-computer system from executing the dynamic system alteration at the same time. This notice may be performed, for example, by setting an indicator to the shared memory, by performing communications between computers, or by locking the shared file. (Steps 201 and 202).

Next, the input/output device use permission setting process 16c prohibits the associative input/output units from being used (Step 203).

Necessary data is added to, deleted from, or changed in the input/output device information part 9 of the input/output configuration reference table 7 for the associative input/output devices, by the input/output device information part changing process 16d (Steps 204 and 205).

After addition, deletion, or change of the input/output device information part 9 has been completed at Steps 204 and 205, necessary data is added to, deleted from, or changed in the input/output device connection information part 9 of the input/output configuration reference table 7 for the associative input/output devices, by the input/output device connection information part changing process 16e (Steps 207 and 208).

After addition, deletion, or change of the input/output device configuration reference table 7 has been completed at Steps 204 to 207, the input/output device use permission setting process 16c permits the associative input/output devices including an added input/output device to be used. Lastly, the dynamic system alteration end notifying process 16f notifies the end of a dynamic system alteration to all computers. (Steps 208 and 209).

After one computer 1 executes a dynamic system alteration and other computers 1 receive the notice of the end of a dynamic system alteration by the dynamic system alteration end notifying process 16f, the other computers can refer to the altered configuration reference table 7 without being explicitly given the changed contents.

The associative input/output device identifying process 16a of the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 13.

It is checked whether associative input/output devices of all computers 1 have been identified (Step 801).

An associative input/output device of the next computer 1 is identified (Step 802).

5 The dynamic system alteration start notifying process 16b of the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 14.

It is checked whether the start of a dynamic system alteration has been notified to all computers (Step 901).

The start of a dynamic system alteration is notified to the next computer (Step 902).

10 The input/output device use permission setting process 16c of the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 15.

It is checked whether use of associative input/output devices of all computers has been prohibited (Step 1001).

15 Use of associative input/output devices of the next computer is prohibited (Step 1002).

The input/output device information part changing process 16d of the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 16.

20 It is checked whether alteration of the input/output device configuration reference table 7 has been completed (Step 1101).

In the case of computer alteration, addition/deletion 30 (FIG. 1B) of a computer is performed (Steps 1102 and 1103).

In the case of input/output device alteration, addition/deletion 13 of an input/output device is performed, and the identification information 11 is generated (Steps 1104 to 1106).

35 The input/output device connection information part changing process 16e of the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 17.

It is checked whether alteration of the input/output device configuration reference table 7 has been completed (Step 1201).

The connection information 12 is altered (Step 1202).

The dynamic system alteration end notifying process 16f of the system alteration procedure 16 of the configuration management program 2 will be described with reference to the flow chart shown in FIG. 18.

45 It is checked whether the end of a dynamic system alteration has been notified to all computers (Step 1301).

The end of a dynamic system alteration is notified to the next computer (Step 1302).

50 Next, the procedure of a dynamic system alteration will be described with reference to FIGS. 1, 2, 4, and 7.

For the preparation of the dynamic system alteration, the system generation procedure 15 of the configuration management program 2 runs on one of computers 1 to generate the changed data file 6 which may be generated at any time before the dynamic system alteration.

55 The dynamic system alteration is executed by the system alteration procedure of the configuration management program 2 running on one of computers 1.

The input/output device configuration reference table 7 has the status (a) depicted in FIG. 7 before the dynamic system alteration. In this case, all computers 1 can use possible associative input/output devices as indicated at 7a.

60 65 After the input/output device use permission process 16c is executed, the input/output configuration reference table 7 has the status (b) depicted in FIG. 7. In this case, all

computers 1 cannot use the associative input/output devices as indicated at 7b.

While the input/output device information part changing process 16d and the input/output device connection information part changing process 16e are executed to change the contents of the input/output device configuration table 7 in accordance with the changed data file, the table 7 has the status (c) depicted in FIG. 7. Also in this case, all computers 1 cannot use the associative input/output devices as indicated at 7c.

After the dynamic system alteration end notifying process 16f is executed to notify the end of a dynamic system alteration, the input/output configuration reference table 7 has the status (d) depicted in FIG. 7. In this case, all computers 1 are allowed to use the associative input/output devices as indicated at 7b, by referring to the changed input/output configuration reference table 7.

After the completion of the dynamic system alteration, an added input/output device or an added computer is permitted to use.

According to the embodiment of the invention, in a multi-computer system having a plurality of computers, any computer can define the configuration of input/output devices irrespective of whether they are shared or not. A shared input/output device is not required to be defined by all computers. Accordingly, system generation is established only by a single system generation operation so that the efficiency of system generation can be improved.

Further, according to the embodiment of the invention, when a computer is booted up, the input/output device configuration definition table is read from the shared file and transformed into the input/output configuration reference table having the format allowing the reference by each computer for the execution of data input/output of each input/output device. The input/output configuration reference table is then stored in the shared memory. Accordingly, the other computers booted up thereafter are not required to read the input/output configuration definition table, so that the computer boot-up time can be shortened.

Furthermore, according to the embodiment of the invention, the input/output configuration definition table and the input/output configuration reference table each have the input/output device information part and the input/output device connection information part arranged in a matrix form. Accordingly, addition, deletion, or change of an input/output device and a computer can be easily performed without any constrain so that the flexibility of system configuration can be improved.

As described so far, according to the present invention, it is possible to collectively manage the input/output device configuration definition table for storing the data defining the configurations of all input/output devices used by a multi-computer system and the input/output device configuration reference table transformed into the format allowing the reference by each computer for the execution of data input/output of each input/output device. Accordingly, the input/output device configuration definition table and the input/output device configuration reference table can be dynamically updated when there is a need of alteration of input/output devices and computers of the multi-computer system.

The invention can therefore improve the system generation efficiency, shorten a system boot-up time, and improve the system configuration flexibility.

What is claimed is:

1. An input/output device information management method for a multi-computer system having a plurality of computers and a plurality of shared input/output devices, each of said shared input/output devices being coupled with

at least two of said computers, said input/output device information management method comprising the steps of:

storing only one configuration information for each of said shared input/output devices, in a shared storage area accessed by, and connected to, the plurality of computers; and

referring to said one configuration information for each of said shared input/output devices stored in said shared storage area to select at least one of said shared input/output devices that adapted the requirement of the computers,

wherein said one configuration information for each of said shared input/out devices includes an information part and a connection information part for the input/ output device, and said computers access the input/ output device by referring to the configuration information.

2. An input/output device information management method according to claim 1, wherein one of the computers in the multi-computer system changes said input/output device configuration information stored in said shared storage area to change said at least one shared input/output device selected by the computers.

3. The input/output device information management method according to claim 1, wherein:

when adding a shared input/output device to the multi-computer system, deleting a shared input/output device from the multi-computer system, or changing a shared input/output device of the multi-computer system, one of the computers in the multi-computer system modifies the input/output device configuration information stored in the shared storage area.

4. The input/output device information management method according to claim 3, wherein:

when adding an input/output device to the system or changing an input/output device of the system, at least one of an address and a name of added or changed input/output device is checked that it is not registered twice in the input/output device configuration information.

5. The input/output device information management method according to claim 1, wherein:

when changing a shared input/output device of the multi-computer system, one of the computers in the multi-computer system modifies the shared input/output device configuration information corresponding to the changed device in the shared storage area, the information including at least one of an attribute, a name, and an address of the shared input/output device, and the other computers in the multi-computer system refer to the input/output device configuration information to access the shared input/output device.

6. The input/output device information management method according to claim 1, wherein:

when adding a computer to the multi-computer system, deleting a computer from the multi-computer system, or changing a computer of the multi-computer system, one of the computers in the multi-computer system respectively adds, deletes or modifies a computer connection information in the input/output device configuration information stored in the shared storage area so that the added or modified computer refers to the information to access the plurality of shared input/ output devices.

7. The input/output device information management method according to claim 1, wherein:

when changing the input/output device configuration information, either notifying the computers in the

multi-computer system that the input/output device configuration information will be changed or notifying the computers in the multi-computer system that the input/output device configuration information has been changed.

8. The input/output device information management method according to claim 1, wherein:

when the input/output device configuration information is changed and a target shared input/output device is not selected, information indicating that the target shared input/output device is not available is set in the input/output device configuration information and the input/output device configuration information is changed.

9. A computer system having a plurality of computers comprising:

at least one output device, connected to and shared by the computers;

at least one input device, connected to and shared by the computers; and

a shared memory for storing only one configuration information for said at least one output device and said at least one input device, said configuration information accessed by the plurality of computers and including an information part and a connection information part, wherein each of the computers referring to said configuration information stored in said shared memory to select the input and output devices that adapted the requirement of the computers.

10. A computer system according to claim 9, wherein the computers in the computer system change said input/output device configuration information stored in the shared memory.

11. The computer system according to claim 9, wherein: when adding an input or output device to the computer system, deleting an input or output device from the computer system, or changing an input or output device of the computer system, one of the computers in the computer system modifies the input/output device configuration information stored in the shared memory.

12. The computer system according to claim 11, wherein: when adding an input or output device to the computer system or changing an input or output device of the computer system, it is checked that at least one of an address and a name of an added or changed input or output device is not registered twice in the input/output device configuration information.

13. The computer system according to claim 9, wherein: when changing an input or output device of the computer system, one of the computers in the computer system modifies the input/output device configuration information corresponding to the changed device stored in the shared memory, the information including at least one of an attribute, a name, and an address of each device, and the other computers in the computer system refer to the input/output device information to access the input and output devices.

14. The computer system according to claim 9, wherein: when adding a computer to the computer system, deleting a computer from the computer system, or changing a computer in the computer system, one of the computers in the computer system respectively adds, deletes or modifies a computer connection information in the

input/output device configuration information stored in the shared memory so that the added or modified computer refers to the information to access the input and output devices.

15. The computer system according to claim 9, further including means for notifying the computers in the computer system that the input/output device configuration information will be changed when changing the input/output device configuration information or means for notifying the computers in the computer system that the input/output device configuration information has been changed when changing the input/output device configuration information.

16. The computer system according to claim 9, wherein: when the input/output device information is changed and a target input or output device is not selected, information indicating that the target input or output device is not available is set in the input/output device configuration information and the input/output device configuration information is changed.

17. An input/output device information management method for a multi-computer system having a plurality of computers and a plurality of shared input/output devices, each of said shared input/output devices being connected with at least two—of said computers, said input/output device information management method comprising the steps of:

copying a present input/output device configuration information to a configuration definition working table when a configuration of the input/output devices is changed; and

updating the configuration definition working table in accordance with a configuration change of the input/output devices.

18. An input/output device information management method according to claim 17, further comprising the step of:

copying the updated configuration definition working table to the input/output device configuration information on a shared file when the configuration change is not dynamically performed.

19. An input/output device information management method according to claim 17, further comprising the steps of:

notifying start of a dynamic configuration change to the computers, when the configuration change is dynamically performed;

generating a difference data between the updated configuration definition working table and the present input/output device configuration information;

updating an input/output device configuration information on a shared memory in accordance with the difference data; and

notifying end of a dynamic configuration change to the computers.

20. An input/output device information management method according to claim 19, further comprising the step of:

copying the updated configuration definition working table to the input/output device configuration information on a shared file when the dynamic configuration change is not temporary.

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DOCUMENT- US 6341308 B1  
IDENTIFIER:  
TITLE: Input/output device information management system  
for multi-computer system

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**Claims Text - CLTX (4):**

wherein said one configuration information for each of said shared input/out devices includes an information part and a connection information part for the input/output device, and said computers access the input/output device by referring to the configuration information.

**Claims Text - CLTX (11):**

when changing a shared input/output device of the multi-computer system, one of the computers in the multi-computer system modifies the shared input/output device configuration information corresponding to the changed device in the shared storage area, the information including at least one of an attribute, a name, and an address of the shared input/output device, and the other computers in the multi-computer system refer to the input/output device configuration information to access the shared input/output device.

**Claims Text - CLTX (21):**

a shared memory for storing only one configuration information for said at least one output device and said at least one input device, said configuration information accessed by the plurality of computers and including an information part and a connection information part,

**Current US Cross Reference Classification - CCXR (1):**

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